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WILDLIFE AND THE CITY

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The Urban Ecosystem

WILDLIFE AND THE CITY

No city ever was built for wildlife; yet every city anywhere accommodates wildlife of some kind, and any city abandoned by mankind tilts immediately toward providing habitat for a succession of "beasties."

The Mentor in Frank Herbert's classic science fiction novel *Dune* tells the young prince not to waste time studying "things"—that the only knowledge with survival value is knowledge of how things act over time. If you know enough about *processes* you can predict *things*, and when you can do that, you can be where and when you want to be—or you can arrange to be out of the way.

Wildlife in cities is one of those "things" that indicates processes at work; in this case, it is a thing that can tell us a lot about the health of the urban environment, its "ambience," its quality, its ability to take in energy, organize and maintain structure, and rid itself of wastes. Measured over a long enough time line to provide a parallax view, a city's wildlife can indicate the direction of urban processes—toward healthy diversity and balance, or toward sickness and stagnation.

Beginning in the late 1960's, human concern for the environment has turned our attention away from the mere naming of things (taxonomy) and in the direction of inquiring how they interact, with one another and with their surroundings. As the accent shifted to *process*, the potential for improving the quality of habitat for both humans and wildlife increased by many orders of magnitude.

As the most fabulously successful of the so-called "higher" life forms, human beings have continued to act in accord with the ecological recipe for success; namely, to grab and use all the energy you can command in the endless competition with other species for life. We have used that energy to build cities, to maintain elaborate commerce, to prolong our own lives, and even to appropriate other species and alter them genetically to suit our whimsical fancies.

Having arrived at the present pinnacle of biosphere dominance, mankind can even reflect humorously on its own arrogant conduct, as in the case of the dog show patron who gazed deep into the wistful eyes of a short-legged basset hound and mused "To think—you used to be a wolf!"

Some life forms are too tough, too adaptive, to be manipulated successfully. They will and do survive wherever man does and without making any concessions to human needs or desires. Cockroaches and Norway rats come readily to mind.

The natural ecosystems of the biosphere have been limited only by the genetic potential of the species that occupied the earth and by the range of climatic conditions that influenced the explosion of those genetic potentials.

As a consequence of millenia of adjustment, evolution, modification, change, specialization and extinction, species have tended to groups that captured and used most efficiently the incident and resident energy in those environments. Under such circumstances, ecosystems tended to grade into one another. Boundaries were sharp only where even slight climatic changes had brought about changes in the life forms of the species occupying the ecosystem. Where prairies interfringe the forest, the transition zones are clearly discernible since there is a remarkable difference between grasses, which are the climax species of the prairie, and trees, the climax species of the forest.

The transition between forest and alpine tundra and between forest and arctic tundra also is easy to see, since radically different life forms are favored by the slight changes in the overall climatic conditions that mark these different ecosystems.

Many ecosystems, however, have boundaries not so easy to discern. The merging of tall grass with midgrass and midgrass with short grass is not at all easy to see. Similarly, the transitional phases of all the various forest ecosystems, mixed oak and oak-chestnut, oak hickory and maple basswood, again are not readily visible to the untrained eye. Yet in every case, whether they differ dramatically or merely shade at the edges, ecosystems are definable—each has a distinct area with its unique cast of most successful competitors that reproduce themselves in a holding pattern.

In times of favorable conditions the ecosystem may extend its boundaries. When boundaries are extended, the occurrence is usually on an individual by individual basis, although some communities may persist or extend their borders through natural catastrophic events, such as fire or severe wind or ice storms.

In any event, natural communities tend to be limited by climatic conditions at work over long periods of time. The species that comprise such communities tend to be either elastic or rigid in their life support requirements depending upon the extent and opportunity of their genetic intermixing and the environment factors that bear on their survival and reproductive potential. The populations that occupy an ecosystem reflect the vegetative base that supports their own genetic requirements for survival . . . an intricately interactive process, always in a state of actual or potential flux.

Mobile animal populations have more opportunity to exploit such a resource than do sedentary or sluggish animal populations. Indeed, migratory animals may make only temporary or seasonal use of such ecosystems. The net result of these processes has been to produce a patchwork quilt of ecosystem types. The edges of the patches are easily discernible if the adjacent ecosystems feature such different life forms as, for example,

grasslands and forests. Differentiation is more difficult where the boundaries are intergraded. Where ancient ecosystems did *not* intergrade, as in island situations or where geologic barriers existed, genetic isolation and distinctly divergent evolution occurred.

As ecosystems developed over the face of the earth through geologic time, the species that comprise them evolved—each within the context of its own place in the ecosystem. Their presence and abundance, their dominant form and such characteristics as their tolerance to light, evolved through the genetic interaction of the breeding populations and the conditions of the ecosystem they were part of.

As a consequence of this process, plants as well as animals have developed "ranges;" the resultant genetic elasticity or rigidity has determined how these resident species responded to the variety of climatic conditions to which they have been subjected.

The overall result of these genetic and ecosystem processes has been the evolution of both plant and animal species that vary widely in their climatic and environmental requirements, and their subsequent ability to occupy niches also will have been determined by these same processes.

It can be seen, then, that the areal extent of neighboring ecosystems will have a great influence upon the number and kinds of habitats that occur within them; and the contiguity of habitats will affect the availability of breeding individuals and determine the possibilities for genetic diversity. Species diversity tends to stabilize ecosystems, with greater diversity leading to greater stability. It follows, therefore, that ecosystems occupying less area will tend to be less diverse and therefore less stable, while those occupying large areas are more stable and less subject to change. This is not to say that local change is not continually occurring in large mature ecosystems, but such changes are more easily absorbed within the normal ecosystem processes without changing the fundamental ecosystem processes themselves.

Man for the greater part of his existence on the earth occupied niches in various ecosystems and acted as a part of and in concert with such ecosystems. He was part of the predator-prey relationship; his effect on the ecosystem itself was no different from any other consumer species dependent upon the ecosystem in which it lives.

In short, man like other higher animals had a territory and a home range, and groups from time to time may have migrated between summering and wintering grounds, in natural rhythms with the migrations of animals they preyed upon.

But with the rise of tools and technology, man ceased to be just another primate in the ecosystem. He became man the technological dominant, with the potential to

alter fundamental ecosystem processes through technological rather than ethological or evolutionary changes. Suddenly, the ecological time frames of earth moved to a new and more rapid beat.

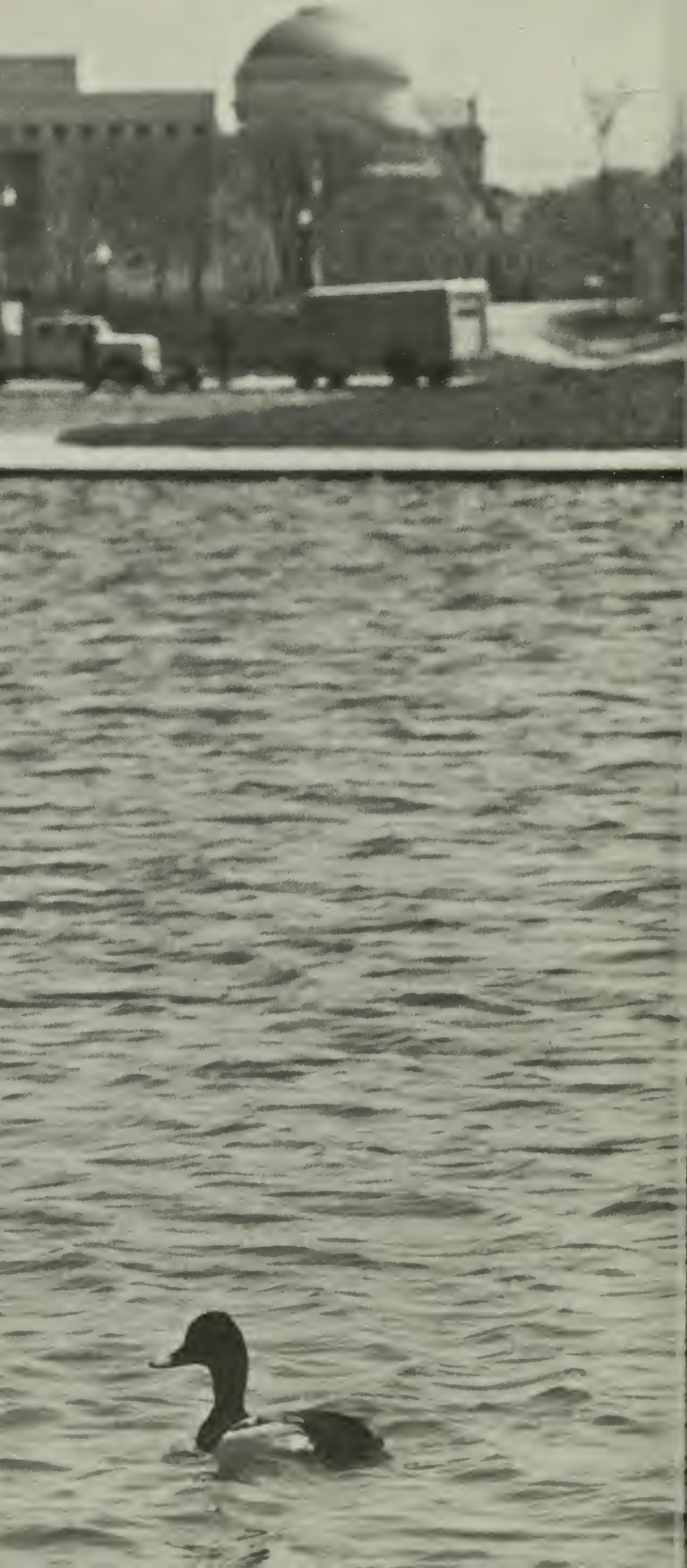
It is postulated that among the earliest victims of man's technology may have been some of the extinct large ungulates known to have lived in North America. Animals such as the Giant Bison are presumed to have been brought to extinction by man the technologically-armed hunter.

The first large-scale alterations to ecosystems however would come when man's developing technology enabled him to shift from subsistence hunting and food gathering to domestication of livestock and the establishment of plant cultivation. These actions seem to have given rise to the city as we know it, a center of developing technology and the economy now aimed at supplying man's wants usually in excess of his needs.

Although it is often presumed that agriculture preceded the development of the city, it is just as reasonable to assume that the city as an ecosystem arose as a technological development of man and made possible the rise of agriculture and the widespread creation of human ecosystems.

The natural ecosystems that man systematically altered to produce his agricultural and urban ecosystem gradually underwent some irreversible changes. The object of plant and animal husbandry is to proliferate a few wanted species in contrast to others deemed either as competitive (and therefore to be eliminated), or worthless (and therefore to be replaced.) Man's increasing technology enabled him to occupy more and more land with agriculture and urban development, and the chopping up of the great natural ecosystems began.

As those areas most suitable for agriculture came under the planting stick or the plow, the landscape and its natural ecosystems began to shift and change. Man's livestock came to occupy the grazing lands, pushing out of existence the animals that normally occupied those ecosystems. It is not true that man's activities merely drove the extant animals into more remote habitats. All of the grazing lands of earth were completely occupied before man began his great technological development. The animals that were driven off the land could not "retreat"—there were no vacant lands for them to fall back on. They simply died. Those that survived were on lands not desired by man or those that could coexist with man. Animals that preyed upon man or his livestock were simply killed as the opportunity permitted. The predators that coexist with man today do so not out of man's compassion for ecosystem diversity, but simply because man has been unable to eliminate them. The coyote comes immediately to mind.



As the original vegetation patterns and ecosystems were altered by man, new ecosystems formed. Primitive agricultural ecosystems at first were confined to grazing lands, which often were extensive in area, and to tilled lands. Early man simply did not have the tools or the technology for large scale development of the landscape, and when he did acquire them, they were used first to regulate water. Thus man's earliest urban technological triumph gave rise to the irrigation civilization of Sumer, Akkad, Assyria, and Babylon in the Fertile Crescent, to the Egyptian development of the Nile Valley, and to the Chinese development of the Yellow River Valley. In these, the earliest of civilizations, the city and agriculture evolved simultaneously, cities rising like volcanic islands out of a sea of agriculture.

The consequent pattern of development provided urban admixtures of the original vegetation, the agriculture vegetation and domestic and wild animals. The city as an ecosystem became a collection of niches that provided habitats for man as well as for other animals and plants. The variety of urban niches in some ways actually provides more diversity than can be found in many ecosystems unmodified by man.

Cities were not planned to include wildlife, nor were they meant necessarily to exclude plants other than shade trees, turf, and ornamentals. In most cases, man does not decide what plants and animals will inhabit a particular city; this decision is imposed upon him by environmental circumstances—climate and the prevailing environmental conditions that make it possible for certain plants and animal life to inhabit an area.

We are accustomed to think of modern city vegetation only in terms of street plants, i.e., shade trees, grass, turf, flowers, and similar cultivations. But in those rare areas of cities that man has not invaded and used for his technology, we are more likely to find the plants and animals that are typical of the surrounding countryside.

In the first cities no doubt there was a continuity of habitat from the surrounding countryside into the city, and probably a great deal of wildlife was present in these cities; we know that many agricultural animals—chickens, sheep, goats, horses, cattle—were kept in cities and considerable agriculture was carried on. Zoning laws against chickens, horses, cows, etc., came late in city life.

It is equally certain that predators and other animals from the surrounding area were frequent visitors to early cities. The cities protected people from the predators that were the natural denizens of the locality and the commons of these cities provided grazing for sheep and other domestic animals under conditions that protected them from marauding wildlife.

Even today there are recorded instances of wildlife wandering into cities that stand adjacent to their habitat. In cities located in the deciduous forest of the eastern

United States—Pennsylvania for instance— it is not uncommon for deer to wander through the towns. In the early 1920's, a black bear was shot in the kitchen of the Hotel Duluth in Duluth, Minnesota. This intrepid beast was stuffed and is now exhibited in that hotel's cocktail dispensary—the Black Bear Lounge.

As cities developed in size and complexitiy, gradually progressing from villages and crossroad market towns to huge metropolitan areas, their impact upon the habitats of natural ecosystems grew enormously. In addition to altering the existing ecosystems, the development of cities created hundreds of thousands of new habitats and new ecosystems.

The city, then, began as a new form of earthly habitat, carved out of natural and agricultural ecosystems that hitherto had harbored only wildlife. In other instances, human use of the land has extirpated the wildlife, or the construction of buildings has destroyed the animals' habitat. Most cities still are contiguous to a rural hinterland of natural ecosystems which provide a continuity of habitat and some cities are even surrounded by native ecosystems. In this way, wildlife still is provided with avenues into and out of similar habitats in the cities, allowing them to be populated by animals from the surrounding countryside.

When we think of the wildlife of the city, we tend to think only in terms of conservation. We think of birds, squirrels and rabbits; in short, those animals that are largely innocuous so far as man is concerned. More realistically we must recognize that city wildlife includes rats, vermin, insects, and all manner of other animal life that does not fit our picture of ideal living conditions for man.

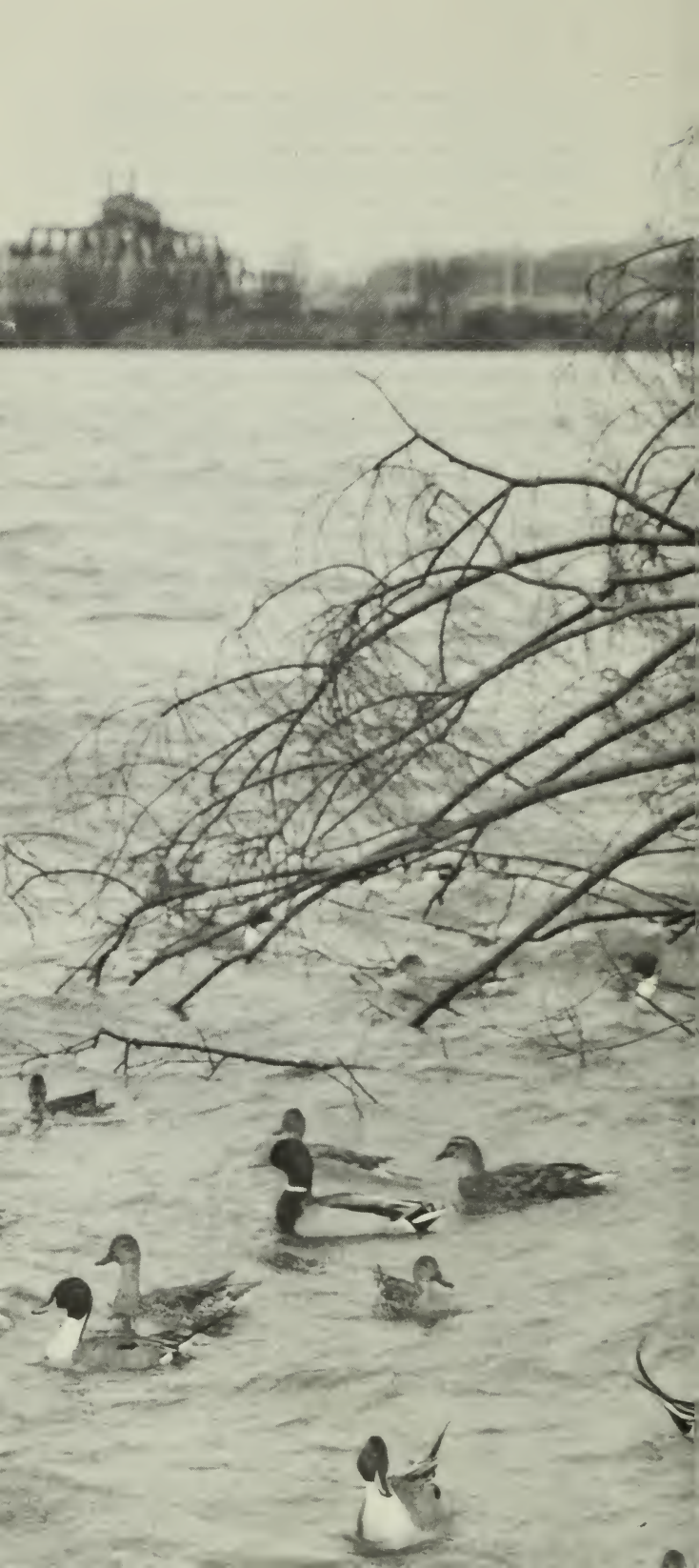
The environment of the city has been modified to provide a habitat for man and to provide the locale and the means to operate man's technology. The animals present fall into three categories: Those that man wants—dogs, cats, horses, chickens, etc.; those that always accompany man wherever he goes and which thrive on his waste products—rats, mice, lice, bedbugs, cockroaches, and so forth; and those that are well-adjusted to the habitat created by man's activities such as pigeons, English sparrows, starlings and bats.

In modern times, some of man's domestic animals have been banished from the city for sanitary, health, or other nuisance reasons. An example is the rooster who disturbs householders with news of the dawn. Even dogs and cats have become so numerous in some cities as to constitute a health hazard and a general nuisance. A great many cattle, sheep, goats, even horses, abounded in cities well into the 1920's. Few cities welcome them today, but horses are used by some city police forces and the mounted police usually are considered the elite among the force. (A six-year waiting period is standard for those seeking duty as mounted policemen in New York City.) One of the few exceptions to the rule against keeping livestock in the city is Phoenix, Arizona. Certain property inside the Phoenix city limits is designated for horse-keeping, and it is not uncommon to see ranch type houses, surrounded by green lawns and split rail fences, with horses grazing in the yard.

Certain animals have been removed from urban ecosystems because they prey on man or on his domestic animals. They have not only been removed from the cities proper but also from the surrounding countryside, which in most cases also is populated by man and his domestic animals. Most of the large wild cats and bears—grizzlies as well as blacks—have been eliminated from areas surrounding cities. Only occasionally, in northern Minnesota or perhaps in Maine, are there reports of black bears wandering into the towns. Grizzly bears can still be seen at the city dump in Cook City, Montana.

Within the cities themselves, a good many animals that are predators of one sort or another—skunks, fox, weasels—also have been removed. It is not certain whether these animals have been systematically extirpated or whether they have disappeared because their habitat has been destroyed or their prey removed.

Many animals have left simply because their living space has been canceled out or altered. When a natural habitat is destroyed, the animals that occupy the new habitat at the same site may be quite different from the original species. For example, when the water environment of a city is degraded, highly desirable species of fish are replaced by so-called rough fish. Pollution is the most probable cause for elimination from stream courses of other kinds of animals such as muskrat and



beaver. Pollution also is the probable cause of the disappearance of wild rice along such rivers as the Potomac. This in turn may have led to the decline in waterfowl along these streams.

The filling of wetlands has been responsible for completely eliminating fish, shellfish, and many fur-bearing animals. Even where the land was not "reclaimed" for city building, drainage has been used to aid in controlling insects, particularly mosquitoes.

It should be noted, however, that in some cities the wetlands have *not* been drained and many enlightened communities have passed legislation to preserve their wetlands. Even so, on the east coast of the United States, the salinity of much of the wetlands has been altered by ditching.

When people choose to live in habitats whose natural conditions are essentially unsuitable for humans, they find themselves at once in conflict with the environment. In many cases, people have employed extreme measures to produce a livable milieu and this has required drastic changes in the natural ecosystems of the area. It does not seem likely that we will abandon these areas since many of our cities are built there, but it is equally certain that at some point we will have to consider a more harmonious relationship with the ecosystems in which we live.

The animals that remain in the city are those that have resisted extermination by man or are compatible with human interests, or which passively occupy niches without interfering with people. In the latter category are squirrels and birds, particularly songbirds. Mankind's desire to make the environment conform to human requirements (lawns and mowed grass, isolated trees, well-trimmed hedges and shrubs), and the desire to live in a healthful environment (one which does not breed disease bearing insects or harbor animals harmful to humans—particularly rodents, poisonous snakes and the like), often puts people into conflict with environmental circumstances. Human ability to achieve all these things and yet to preserve elements of the original ecosystems out of which the city was built, present outstanding opportunities to preserve, conserve, and enjoy nature at the urban doorstep.

Parcels of land that have remained undeveloped and unthreatened from the settlement of the city can be found in the most populous and highly developed cities. On the island of Manhattan can be found places that look like pieces of a city park, but in reality they are bits of the original ecosystem of the island which never have been anything but what they are now.

Most cities have ordinances that require property owners to "clean up" their property—eliminate weeds, wild shrubbery, etc. If the owner fails to treat his vacant lot in this manner, the city will do it and send him the bill. Such activities are in direct conflict with the needs of wildlife. "Cleaning up" for man means destroying the habitat for many quite innocuous animals.

An ordinance in Fairfax, Virginia, a suburb of Washington, D.C., required grass to be mowed to a height of six inches. The ordinance was permanently enjoined with the aid of a Smithsonian botanist, who testified as an expert witness in favor of the meadow with its myriad of flowering plants, its grasses and shrubs. How could shrubs and trees get started if by repeated mowing their stems were reduced to six inches or less? Species diversity, both of plants and animals, increases when cut grass goes to meadow. The aesthetic values of added birdlife, honeybees, rabbits and bright flowers more than make up for the less tidy aspect of the meadow as opposed to the formality of the mowed field.

Yet the Virginia householder had to fight the county health department (which had declared his lot a neighborhood "menance"), to defend his honeysuckle, the dandelions used in the family's homemade soups, and wild floribunda roses. In Akron, Ohio, a court ruled in 1976 in favor of a vegetarian who allowed her lawn to grow. It took another court order to allow a Wisconsin wildlife biologist to let his backyard flourish in "native vegetation."

By simplifying the environment with the removal of wild species of shrubs, flowers, grasses, and other kinds of plants normally described as weeds, and by insisting upon a well-ordered, neat environment, people severely limit the number and the kinds of animals that can be accommodated in otherwise unused parts of the city.

Nevertheless, many cities have declared themselves to be sanctuaries of a sort. The signs as one enters a number of South Carolina urban centers proclaim that they are bird santuaries, and if they are sanctuaries for birds, they must be so for other kinds of animal life as well. All that is required is to maintain the type of habitat necessary to the resident and migratory birdlife, i.e., nesting sites, adequate food, escape from predatory animals (particularly cats, skunks, weasels, and squirrels). In addition, there must be a general appreciation on the part of the human population that birdlife is desirable and is to be protected. In the early part of this century when more than today seed fruit trees were growing in cities, there was an abundance of food for birds. When city lots were not so neatly trimmed and mowed there was an ample supply of wild seed plants, and most cities were surrounded by meadows, agricultural fields, and river and stream valleys that provided much of the habitat for birds.

In 1977, the National Park Service will test the public's tolerance for urban wildness by allowing 10 of the 120 acres of mowed lawn in D.C.'s Rock Creek Park to revert to meadow status. The visual beauty of the resulting varieties of clover, black-eyed Susan, Queen Anne's lace, heal-all, blue-curl, sweet everlasting, St. Johnswort, deptford pink, Knapweed and butter and eggs is not the whole story. With the plants will come a whole assortment of associated insects, moths and butterflies, which, in turn, will attract and sustain more song birds,

small mammals, hawks and owls. As the new growth is left standing over winter, nesting sites become available for rabbits, and seeds are there for wintering birds.

Before the use of hard pesticides, even some birds of prey such as the peregrine falcon were found in the cities. They nested on high buildings and preyed upon birds whose habitat was below theirs. Their principal prey was the pigeon—a bird considered a pest in many places. Then pesticides entered the food chain of the peregrines, causing faulty calcium metabolism and failure of egg hatches. We might consider reintroducing peregrines into cities. The pigeons certainly are there for them to feed upon (peregrines capture them in flight). The cities, were falcons to be reintroduced, might even become critical habitats, since the peregrine falcon is on the endangered species list. In the case of the peregrine, cities could become the refuge instead of the cemetery.

The steel, concrete, and glass towers that comprise much of the downtown areas of our cities are almost entirely devoid of places where plants can live, thus denying vegetative habitats for birds and other animals. The vast adjacent areas we call suburbia have simplified the natural ecosystems of the surrounding countryside so as to destroy much of the living condition necessary for birds and other animals. Particularly destructive is the removal of trees and their replacement by saplings.

Also damaged by the construction of cities has been migratory bird life. Many cities built along the coasts and the riverways of the continent occupy choice places once used by birds on their long journeys north and south. These sheltered places have been filled and used as platforms for cities. Bottomlands, flatlands, sheltered harbors and bays—they were choice environmental places and they assured the success of the birds' migratory journey. When they filled up as cities, the birds had no choice but to alter their flight plans. Some birds, such as the whooping crane, could not make the adjustment. Apparently successful efforts have been made to induce sandhill cranes to hatch out the whoopers and then introduce them to the migratory route of the sandhill cranes.

The building of cities, especially the construction of streets and highways, has destroyed the continuity of habitat. Many highways are fenced, making movement from one side to the other virtually impossible. It is worth noting here that interstate highways, urban beltways and similar projects have destroyed the continuity of habitat not just for wildlife but for human life as well. These enormous rivers of traffic bite into and tear up large, single, contiguous neighborhoods, creating non-viable shards of once healthy communities. The automobile itself is a predator of wild animals, killing large numbers every year. It is a major source of deer mortality in Pennsylvania, a state justly proud of its deer management in all other respects.

Rock Creek Park in Washington, D.C., is a classic example of habitat continuity that has been maintained. Since colonial times almost an entire watershed has been preserved as urban park. Although constructed roadways run through the area, the valley remains largely undeveloped and the stream bed itself provides a north-south passage allowing free movement for many kinds of wildlife.

It must be understood that the same avenues of continuous habitat that provide free access into and out of the city for interesting small creatures can also provide access for animals that are potentially dangerous to humans. In Florida, beginning in the early 1970's, alligator attacks on people began to be reported. The alligator in Florida is on the endangered species list and certainly should remain there. But as their numbers increase, it is only a matter of time and opportunity before alligators will move through the canals that connect South Florida's water conservation districts and into the cities they serve.

These incidents and others like them, such as black bears entering cities in northern Minnesota, naturally arouse public fears and bring calls for swift retaliatory action. But there is no need to stamp out the alligator or any other animal because of isolated attacks on a human. Instead, we should be taking appropriate precautionary measures and promoting public understanding of the continuity of habitat process that permits animals to enter cities from the surrounding countryside. Attacks on humans are isolated and are likely to remain so.

In transforming the natural ecosystem into the ecosystem of the cities, man has generally adapted his agricultural techniques to the task and has planted large areas with a limited variety of species. A sound program of environmental education could easily alert an interested public to the problems this limited vegetation poses for wildlife in the city; the result could be heightened human enjoyment of a richer, more various urban scene.

The restricted plant life of the city is vulnerable to pests and diseases that would not threaten a more diverse selection. Planting of disease-prone trees, grasses and shrubs, or the large-scale planting of a single cultivar or variety that could become vulnerable to disease is a hazard that comes with imposing even a modified form of agriculture monoculture. Much more variety could and should be introduced into city landscaping, not only by urban ecosystem managers, but also by home owners in their yard plantings.

By constructing buildings, man provides habitat for cockroaches, termites, bedbugs and the like. The pets people keep—dogs and cats—carry parasites such as fleas and lice, some of which can be transmitted to man. Human buildings and houses also provide habitats for spiders, centipedes and millipedes, which prey upon cockroaches and therefore are a biological control for these household pests. Pest insects usually are found in the same garden with other insects that eat them. The application of pesticides is a poor control method, since it kills both predator and prey. At best, it is an uncertain method of bringing about a balanced ecosystem. Proper uses of pesticides can be a help in controlling household and garden pests, but generally these substances are used to excess. It would be difficult to estimate accurately the impact of household pesticide use upon the wildlife of the city but it must be severe. The average householder, in attempting to control pests over a relatively small area, tends to overdose the area treated. The cost to the householder in terms of dollars is negligible, but the cost in vitality of the ecosystem in all likelihood is enormous. Urban householders, in their desire for "putting-green" lawns, often kill their shade trees inadvertently. It's the broad-leafed weeds in the lawns they are after when they pour on the herbicides, but it's the broad-leafed trees that accidentally take the Sunday punch.

In a number of cities, particularly San Diego and one area in New Jersey, fairly large tracts of land are being set aside where large animals are permitted to roam freely. The San Diego Zoo is known throughout the world because its animals are maintained in "natural conditions." Zoos in general, however, including those mentioned above, are maximum security prisons for animals that are too dangerous to cohabit the same environment as man. However, in a number of cities in India, where the monkey is considered sacred, large numbers of monkeys inhabit cities and villages and even ride the trains. By some they are considered pests, by some they are tolerated, and by some they are venerated.

Over the long haul of time, the growth of cities has taken an enormous toll of wildlife habitats and affected those remaining in a number of ways. First, the construction of the city has completely destroyed many habitats and has modified others. The former is particularly true where wetlands have been filled. Second, the construction of cities has altered or destroyed migratory routes. In a few cases, modification has been a wildlife boon—such as properly planted cities where large numbers of street trees have proliferated the "edge effect" of the forest and thus provided more habitat for birds than a natural forest in the same area.

The natural components of the city, however, form a new ecosystem that can contain some but not all of the animals previously present. In considering wildlife and the city we must ask whether there are habitat connections with the hinterland, the stream valley, the greenbelt, the river, the watershed, or the lake that remain undeveloped. Are there pockets of natural vegetation in the form of parks? Are there trees along the streets? Are the yards and gardens of the city dwellers suitable habitat for much of the natural wildlife that we find pleasing? Are there food plants?

Probably food plants are the single most important factor in attracting wild birds to the city. Our penchant for neatness severely limits the growth of food trees, particularly wild black cherries and other seed plants that most attract birds. By eliminating kitchen gardens and replacing them with shade trees and turf, we have further inhibited urban wildlife.

Yet the feeding of birds in many cities is big business. Most hardware stores sell wild bird seed mixtures and suet seed cakes, as well as bird feeders, bird houses, and an array of apparatus and paraphernalia for feeding and housing birds.

In most cities, the larger and more dangerous animals have been eliminated or destroyed and the rest have fitted themselves into the niches that remain. The animal wildlife, like the plant life, can be a bioassay for the quality of life, and this aspect of wildlife in the city is perhaps as important as any other. Songbirds, squirrels, game fish in the streams, racoon, mink and beaver, all are indicators of a quality environment. Rats and vermin, houseflies, cockroaches, and similar insects are indices showing that the environment is in poor condition. Wild bird populations that are limited to starlings and sparrows indicate over-simplification, a down-grading of the environment.

Since humans control the city ecosystem, they can and should regulate wildlife. When they abdicate this responsibility, the quality of all life suffers. Cats and dogs

have become feral and in many instances must now be considered a part of the wildlife in urban predator/prey relationships. In suburban areas where dogs are kept for companionship or for protection, many are permitted to run loose. Children and adults are in danger of being attacked by the packs that inevitably form under these circumstances. Feral dog packs have been reported in such diverse locations as Montgomery County, Maryland, Beverly Shores in the Indiana Dunes, and in numerous Southern towns. In one of the latter, a poll taken among school children showed that their greatest fear was attack by a dog pack. It is possible that coyotes, foxes, and wolves regulate house cats and in some instances dogs too. Authenticated records testify to red foxes preying upon cats, and it is now a common sight to see coyotes in the suburbs of Los Angeles where not a few pets become their prey.

The answer to control of wildlife in the city, as in all wildlife programs, lies in habitat management. If a city is to accommodate wildlife, it must not only accommodate the physical presence of the animal but also provide a home range for it. Large ungulates and large carnivores, in addition to being potentially dangerous to man, require more space for adequate home ranges than a city is able to provide.

In addition, there is the need of migratory animals for continuity of habitat. Whether they are moving north and south or migrating from winter to summer feeding ranges, such animals cannot make their necessary journeys without the life support systems provided by a dependable string of habitats along their ways. Moreover, the biological quality of the habitat and protection from predation by man is important. Migratory animals must have adequate cover, abundant food, and if the animal is shy of man, there must be easy escape from man and his activities.

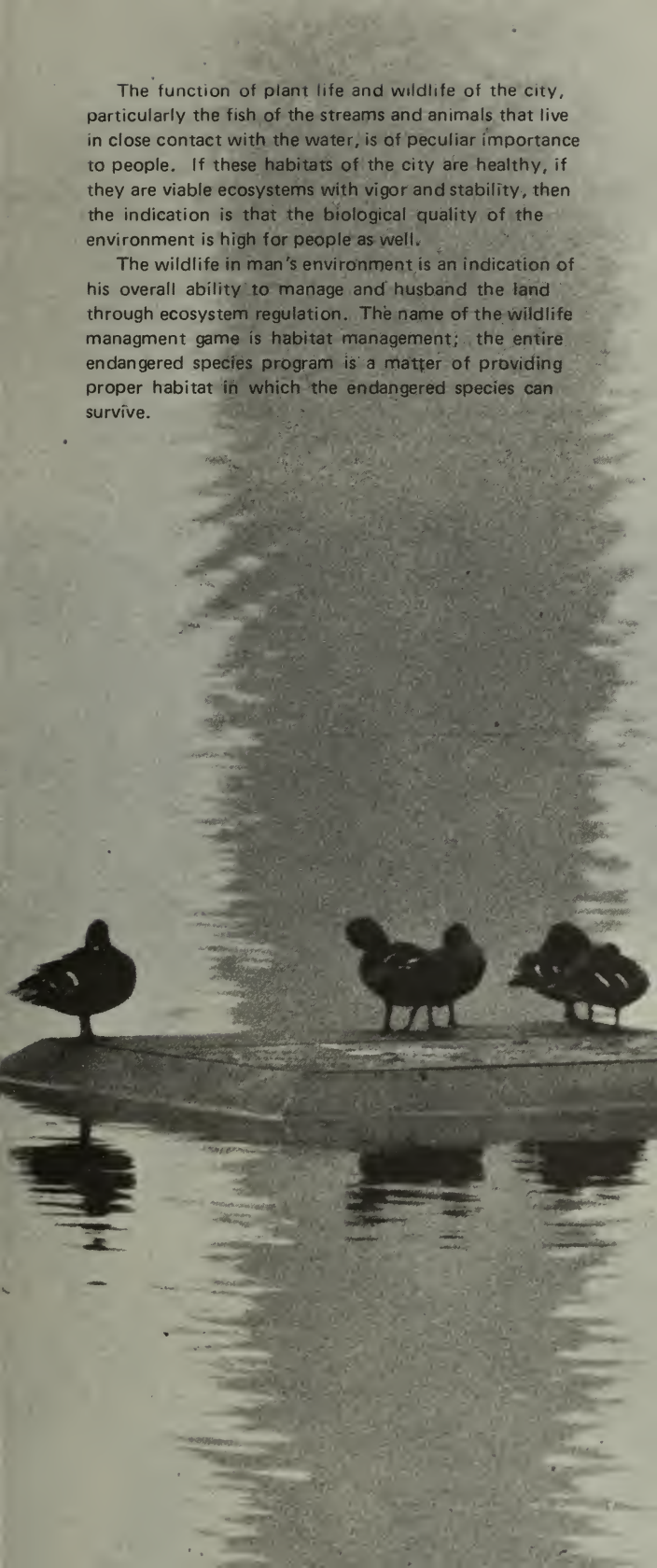
The chemical quality of the habitat is another consideration. This centers around the quality of two essential elements—air and water. Water and air pollution have the effect on natural ecosystems of "simplifying" them by eliminating some of the components. The result of a system thus made poorer is to lower the efficiency of energy use; fewer ecological niches, fewer resident life forms, a less diverse and less energetic system.

Man is *not* a good "bioassay" for air and water quality. All the plants of the city and fish in the streams could die from lowered chemical quality of the habitat before man would consider himself seriously damaged by the quality of the air and water. There is ample evidence—in places like Mexico City, Tokyo, and Los Angeles, to name three—that the pollution of air and water severely stresses the vegetation. Yet man continues to live in these areas, apparently only slightly inconvenienced by the enormous pollution.

City dwellers take their water supplies from rivers that are incapable of nourishing anything but trash fish. A recent study of the Potomac River showed that while the water is unlikely to be lethal to humans, a great number of chemical pollutants are present in concentrations just low enough not to constitute a direct threat to man. The Potomac pollutants are not the kinds of materials that are removed by water treatment prior to consumption by man.

The function of plant life and wildlife of the city, particularly the fish of the streams and animals that live in close contact with the water, is of peculiar importance to people. If these habitats of the city are healthy, if they are viable ecosystems with vigor and stability, then the indication is that the biological quality of the environment is high for people as well.

The wildlife in man's environment is an indication of his overall ability to manage and husband the land through ecosystem regulation. The name of the wildlife managment game is habitat management; the entire endangered species program is a matter of providing proper habitat in which the endangered species can survive.



The same principles apply to wildlife in the city. If the habitat for urban wildlife is properly managed, the city will have a healthy wildlife population. The manner, type, and quality of habitat will determine the manner, type, and quality of the animals that inhabit it.

Man is just beginning to understand the regulation of ecosystems. Single-minded exploitation of the environment for single-purpose motives is giving way to analysis of the multifaceted ecosystem; the optimization of the total ecosystem value is being considered at last, rather than pushing for any single factor or set of factors. We are moving away from the concept that led us to exploit ecosystems and environments for single commodities and beginning to recognize the benefits to be reaped from maintaining whole, healthy ecosystems.

When the optimization of the ecosystem of the city is considered over the maximization of any single use of it, we will discover that the wildlife of the city is far more than a mere entertainment or ornamentation. It is the barometer by which we can judge the overall quality of life. It will not benefit mankind to exploit ecosystems if in so doing the wildlife it harbors is destroyed.

The "whole ecosystem" concept is based on stabilization of the energy flow that produces the various and diverse components of the ecosystem. Human regulation of this process means that if the ecosystem is husbanded, maintained, and kept in good working order, an abundance of materials and goods are available for man's use.

The wildlife and plant life of the city are an integral part of the living components of the human ecosystem. Their life, their health, their viability are directly related to the health and viability of people. The character and quality of the ecosystem will be determined by the character and quality of human management of the ecosystem. Man can easily be judged by the company he keeps.

The presence of songbirds, squirrels, and other animals that are pleasing to the ear and the eye, the presence of bass, pike, sturgeon, and other desirable game fish, all tell us a great deal about man and his ecosystem. On the other hand, if man's companions are lice, vermin, and the trash fish of his polluted streams, we can deduce much about the way he manages his ecosystem.

We have yet to understand fully and calculate all the additional wealth to be derived from a healthy ecosystem. When such a cost/benefit ratio sheet is drawn up, we will have no other recourse than to conclude that single-factored exploitation of the environment for the benefit of the few causes deterioration of the ecosystem as a whole, with consequent loss to all.

When the viability of the human ecosystem is recognized as essential to the system's wealth-producing capacity, the corrective measures necessary to make the systems healthy and viable for man and wildlife will be taken forthwith.

The city provides a marvelous opportunity for humanity to display its inventive genius—not only in providing areas of scenic beauty but in the exercise of technology blended with good ecosystem concepts in ways that preserve the natural diversity and even provide habitat for endangered species.

The most common example of this is in the design of city parks. City parks can be completely formal gardens that also contain niches for wildlife. The formal park can add to its formal plantings certain water plants that will attract waterfowl and support a turtle population. The walks and borders can include shrubs and other plantings with edible seeds or fruits. Such gardens and ponds with the wildlife they attract require less maintenance, and this by no means exhausts the list of advantages.

Perhaps the ecological tour de force of urban wildlife planning is the concept of the rooftop refuge. The rooftop refuge has the modern potential of the hanging gardens of ancient Babylon—those enormous masonry works with terraces supported by arched columns that qualified as one of the Seven Wonders of the World. Large enough to support summer homes complete with gardens, these terraces rose above the Tigris-Euphrates floodplain to catch the breeze and provide a vista. The upper surfaces of the terraces were thatched with reed and plastered with mud. They were then covered with lead sheets and sealed with pitch and tar. Over this now water-impervious surface, soil was placed in which the plantings were made and upon which the buildings were built. A system of pumps lifted water from wells beneath the gardens to the highest terrace, where by gravity flow the entire hanging gardens were watered. The surplus water was returned to the well.

Rooftop refuges could occupy many acres of building tops in cities of all sizes. Like the hanging gardens, they would be integral with the roofs on which they were placed. Such a scheme could markedly reduce the cost of roof maintenance by eliminating the environmental stress on roofs subjected to extremes of temperature—thawing and freezing and attendant water penetration.

The roof would be sealed with a moisture barrier buried under several feet of soil and then planted with a variety of plants from grasses and herbs to trees. The plantings could be formal and provide people spaces, such as restaurants or rooftop cocktail lounges, or could be wild with little or no human intrusion. The main fact to consider at this juncture is the engineering function of the rooftop refuge, which simply is a weatherproof roof seal that reduces roof maintenance. The attendant aesthetic qualities of living plants and animals and the notion of endangered species refuges, are spin-off benefits. But what benefits!

This is the ideal habitat for the urban peregrine falcon and myriad songbirds. Moreover, rooftop refuges would be ideal habitat for sedentary amphibians and reptiles—like salamanders and turtles and snakes. The areas of the city that seem the most devoid of life could have life literally "spring from the rooftops," providing isolated and secure niches for many plants and animals, and a continuity of habitat for many insects and birds that could then travel safely between them. They would be literally islands of vegetation floating above the city—testimony to the technological genius and the ecological wisdom of man—bespeaking his understanding of the relationship between the natural ecosystems of the biosphere and the technological ecosystem of man.

In concert with whole-ecosystem planning of urban parks, the city rooftop refuge could crown the achievements of managers in providing optimum habitat for *all* the inhabitants of the city. A well-known axiom in wildlife management says the most biologically productive land produces the most and best wildlife. Adapting this concept to the city would help close a gap between man and his environment and would provide a solid management basis for judging the effectiveness with which technological man can come to grips with balancing his books and nature's. The presence of hawks, trout, sturgeon, weasels, squirrels, martins, beaver, deer, quail, and other remaining treasures of the life forms of earth in the city environment would be living proof of man's success in achieving on-going partnership with nature.

—Theodore W. Sudia

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